Outcome, Return to Work and Health-Related Costs After Aneurysmal Subarachnoid Hemorrhage

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Abstract: OBJECT: Data on health-related costs after aneurysmal subarachnoid hemorrhage (aSAH) are limited. The aim was to evaluate outcome, return to work and costs after aSAH with focus on differences between high- and low-grade aSAH (defined as World Federation of Neurological Surgeons [WFNS] grades 4-5 and WFNS 1-3, respectively). METHODS: A cross-sectional study was performed, including all consecutive survivors of aSAH over a 4-year period. A telephone interview was conducted to assess the Glasgow Outcome Scale Extended and employment status before and after aSAH. Direct costs were calculated by multiplying the length of hospitalization by the average daily costs. Indirect costs were calculated for productivity losses until retirement age according to the human capital approach. RESULTS: Follow-up was performed 2.7 years after aSAH (range 1.3-4.6). Favorable outcome was achieved in 114 of 150 patients (76%) and work recovery in 61 of 98 patients (62%) employed prior to aSAH. High-grade compared to low-grade aSAH resulted less frequently in favorable outcome (52% vs. 85%; $p < 0.001$) and work recovery (39% vs. 69%; $p = 0.013$). The total costs were € 344.277 (95% CI 268.383-420.171) per patient, mainly accounted to indirect costs (84%). The total costs increased with increasing degree of disability and were greater for high-grade compared to low-grade aSAH (€ 422.496 vs. € 329.193; $p = 0.039$). The effective costs per patient with favorable outcome were 2.1-fold greater for high-grade compared to low-grade aSAH (€ 308.625 vs. € 134.700). CONCLUSION: Favorable outcome can be achieved in a considerable proportion of high-grade aSAH patients, but costs are greater compared to low-grade aSAH. Further cost-effectiveness studies in the current era of aSAH management are needed.

DOI: https://doi.org/10.1007/s12028-019-00905-2

OUTCOME, RETURN TO WORK AND HEALTH-RELATED COSTS AFTER ANEURYSMAL SUBARACHNOID HEMORRHAGE

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Word Count: 2922

Number of Figures: 5

Number of Tables: 5

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Key Words

Subarachnoid Hemorrhage, Outcome, Employment Status, Cost

DETAILS PAGE

The manuscript complies with all instructions to authors and authorship requirements have been met. The final manuscript was approved by all authors. The manuscript has not been published elsewhere and is not under consideration by another journal. The study protocol was approved by the local ethics committee of the University Zurich, Switzerland (Ref. Nr. EK: KEK-ZH-Nr. 2011-0429). All authors have nothing to disclose.

ABSTRACT

Object: Data on health-related costs after aneurysmal subarachnoid hemorrhage (aSAH) are limited. The aim was to evaluate outcome, return to work and costs after aSAH with focus on differences between high- and low-grade aSAH (defined as World Federation of Neurological Surgeons (WFNS) grades 4-5 and WFNS 1-3, respectively).

Methods: A cross-sectional study was performed, including all consecutive survivors of aSAH over a 4-year period. A telephone interview was conducted to assess the Glasgow Outcome Scale Extended (GOSE) and employment status before and after aSAH. Direct costs were calculated by multiplying the length of hospitalization by the average daily costs. Indirect costs were calculated for productivity losses according to the human capital approach.

Results: Follow-up was performed 2.7 years after aSAH (range 1.3- 4.6). Favorable outcome was achieved in 114 of 150 patients (76%) and work recovery in 61 of 98 patients (62%) employed prior to aSAH. High-grade compared to low-grade aSAH resulted less frequently in favorable outcome (52% versus 85%; p<0.001) and work recovery (39% versus 69%; p=0.013). The total costs were € 344.277 (95% CI 268.383 – 420.171) per patient, mainly accounted to indirect costs (84%). The total costs increased with increasing degree of disability and were greater for high-grade compared to low-grade aSAH (€ 422.496 versus € 329.193; p=0.039). The effective costs per patient with favorable outcome were 2.1-fold greater for high-grade compared to low-grade aSAH (€ 308.625 versus € 134.700).

Conclusion: Favorable outcome can be achieved in a considerable proportion of high-grade aSAH patients, but health-related costs are greater compared to low-grade aSAH. Further cost-effectiveness studies in the current era of aSAH management are needed.

INTRODUCTION

Improved aneurysm treatment modalities and advances in neurocritical care have resulted in a paradigm shift over the past decades with regards to treatment options and potentially good prognosis after high-grade aneurysmal subarachnoid hemorrhage (aSAH), defined as World Federation of Neurosurgical Societies (WFNS) grades 4 and 5 [1,2]. In recent studies, the authors have suggested that early aneurysm treatment in combination with neurocritical care can result in functional independence in more than half of the patients with high-grade aSAH [3,4]. However, high-grade aSAH patients have a long-term ICU-stay aiming to prevent secondary brain injuries, and in many cases also require long-term rehabilitation programs to achieve the best possible functional outcome.

To date, there are only few health economic evaluations estimating the contemporary costs in the current era of aSAH management [5,6]. The economic costs of aSAH in the United Kingdom have been estimated at £ 510 million in 2005 including the costs from in-hospital treatment which account for 59% of the total costs [7]. A German study reported that costs per patient were € 38.300 within the first year after aSAH, of which 59% resulted from acute in-hospital treatment and 41% from productivity losses due to failure to return to work [8]. Further insights on healthcare costs with regards to functional recovery and working capacity are important to assess the effectiveness of aSAH management today.

The aim of the study was to investigate outcome, return to work and costs after aSAH in a cohort of consecutive aSAH survivors treated at a single center in Switzerland with the focus on high-grade aSAH.

METHODS

Patient Population

The patients were selected from a prospective database of consecutive aSAH patients, treated between January 2007 and August 2010 at the Neurocritical Care Unit, University Hospital Zurich, Switzerland. All patients were treated according to a standardized treatment protocol including early aneurysm occlusion (within 24-48 hours) using surgical clipping or endovascular coiling after interdisciplinary discussion and maximal neurocritical care including barbiturate coma and therapeutic hypothermia as a last resort therapy option in patients with high intracranial pressure and/or delayed cerebral ischemia refractory to conventional treatment [9,10]. Patients deceased or living abroad were excluded from the study. All other patients were invited by mail to participate in a structured telephone interview about their neurological recovery and employment status. Patients were excluded if informed consent could not be obtained from the patient or their legal representative. A flow chart of the patients included in the study is presented in Figure 1. The study protocol was approved by the local ethics committee of the University Zurich, Switzerland (Ref. Nr. EK: KEK-ZH-Nr. 2011-0429).

Patient Characteristics

The following data from the prospective institutional database were analyzed: age at time of aSAH, gender, WFNS score, Fisher grade, aneurysm location, type of aneurysm treatment, and Glasgow Outcome Score (GOS) at 3 and 12 months after aSAH. The severity of aSAH was classified as low-grade in patients with WFNS scores 1-3 or high-grade in patients with WFNS score 4-5. The length of stay in the neurocritical care unit, neurosurgical ward and rehabilitation unit was analyzed from the electronic patient files.

Telephone Interview About Functional Outcome and Return to Work

In August 2011, a single investigator (D.O.) conducted a structured telephone interview to assess outcome and employment status. Standardized questionnaires for assessment of the Glasgow Outcome Scale (GOS) and Glasgow Outcome Scale-Extended (GOSE) were used to measure the level of disability and dependence as previously reported [11]. Key features of both outcome scales are presented in Table 1. Questions on work recovery were adapted from a previous study on return to work after aSAH [12]. Return to work was defined as the resumption of productive activities and assessed by asking the patients about the type of job and workload (percentage of weekly working hours) before and after aSAH. In case of incomplete recovery, the patients were asked to report their complaints. The responses of patients were categorized into (1) complete work recovery, (2) incomplete work recovery, (3) failure to return to work due to health problems related to aSAH, or (4) early retirement after aSAH.

Health-Related Costs

Health-related costs were calculated for the period between the day of aSAH and follow-up. The total costs included costs for inpatient care (direct costs) as well as productivity losses due to problems related to aSAH (indirect costs). Direct costs were based on the average daily hospital and rehabilitation costs derived from the Swiss Federal Statistical Office (www.bfs.admin.ch) and calculated by multiplying the length of stay by the average daily costs. Indirect costs for gainfully employed patients prior to aSAH were calculated according to the human capital approach as reported previously [8]. For productivity losses due to sick leave, the mean gross income given by the Swiss Federal Statistical Office (www.bfs.admin.ch) was divided by 365 days and then multiplied by the days of hospitalization and rehabilitation. In patients with failure to return to work, additional productivity losses were added for the time until the 65th birthday, which is the official retirement age in Switzerland. In patients with incomplete work recovery, productivity losses were adjusted to the percentage of reduced

workload. All costs are expressed in Euro (in 2009 1 Euro (€) = 1,4878 Swiss Franc = 1,4325 US Dollar).

Statistical Analysis

Baseline characteristics, outcome scores, return to work, and health-related costs were analyzed separately for low-grade aSAH (WFNS 1-3) and high-grade aSAH (WFNS 4-5). For statistical analysis the outcome was dichotomized into favorable (GOSE 5-8) and unfavorable outcome (GOSE 2-4). Data are presented as median with interquartile range (IQR) or mean with 95% confidence interval (CI) where applicable. Differences between groups were compared using the Mann-Whitney U Test or Fisher test. To evaluate the cost-effectiveness, we calculated the effective costs per patient with favorable outcome (GOSE 5-8), defined as the costs for all patients divided by the number of independent patients as previously reported [13]. Statistical analysis was performed using PRISM 8 (GraphPad Software, Version 8.0.1, USA).

RESULTS

Patient characteristics are shown in Table 2. Of the 150 patients, 42 had high-grade and 108 low-grade aSAH. High-grade aSAH was significantly more often associated with Fisher 3 and 4 bleedings, posterior circulation aneurysms, rescue therapies, and longer stay in the intensive care unit, neurosurgical ward and rehabilitation unit. The GOS at 3 and 12 months after aSAH as well as long-term follow-up was lower after high-grade compared to low-grade aSAH. Age, gender, employment status, aneurysm treatment modality and disposition after hospital discharge were comparable between both groups. The median time interval between aSAH and the telephone interview was 2.7 years (range 1.3 - 4.6 years)

Functional Outcome

The distribution of GOS (Figure 2) was significantly different when comparing 3-months and 12-months follow-up ($p<0.001$), but there was no difference comparing 12-months and long-term follow-up ($p=0.684$). The percentages of individual changes in GOS between 12 months and long-term follow-up are shown in Figure 3. GOS improvements were recorded in 1 of 38 patients (2%) at 3 years, 3 of 42 patients (7%) at 4 years and 6 of 20 patients (22%) at 5 years after aSAH. A decline in GOS was observed in 1 of 38 patients (3%) at 2 years, 3 of 42 patients (7%) at 3 years, and 1 of 20 patients (4%) at 5 years after aSAH. Functional outcome according to the GOSE scores at long-term follow-up is presented in Table 3. Overall median GOSE was 7.0 (IQR 5.0-7.0) and favorable outcome (GOSE 5-8) was achieved in 114 of 150 patients (76%). Thirty-five patients (23%) were severely disabled (GOSE 3-4) and 1 patient (1%) in a condition of unconsciousness (GOSE 2). High-grade compared to low-grade aSAH was associated with significantly less favorable outcome according to GOSE 5-8 (52% versus 85%, $p<0.001$).

Return to Work

Work recovery is presented in Table 4. In the group of 98 patients who were employed prior to aSAH (mean age 50 ± 9 years), 61 (62%) reported work recovery. Complete work recovery was achieved in 36 patients (37%) with a mean age of 47 ± 9 years. In the group with incomplete work recovery (mean age 47 ± 10 years), all patients were working fewer weekly hours with a mean proportional reduction from 86 ± 19% to 48 ± 19% ($p<0.001$). Of the 28 patients (29%) not returning to work (mean age 51 ± 6 years), 24 (86%) were unemployed due to aSAH-related health problems, 3 (11%) were looking for employment with a reduced workload and 1 (3%) had stopped working to take care of household and family. There was no difference in time to follow-up between 61 patients who returned to work fully or partially and those 28 patients with failure to return to work (2.6 years (range 1.3 – 4.6) versus 3.1 years (range 1.5 – 4.6);

p=0.1). Early retirement was reported in 9 patients (mean age 64 ± 4 years). Overall, work recovery was less frequent in high-grade compared to low-grade aSAH (39% versus 69%; p=0.013).

Health Care Costs

The costs per patient and total costs are shown in Table 5. The average costs per patient were calculated at € 344.277 (95% CI 268.383 to 420 171). Indirect costs accounted for 84% of total costs per patient and were mainly due to failure to return to work (66%). Per patient costs for acute in-hospital treatment were € 33.220, which made up for 59% of total direct costs. The absolute total costs were calculated at € 51.641.553.

The costs per patient between high-and low-grade aSAH are depicted in Figure 3. Total costs per patient were greater for high-grade aSAH compared to low-grade aSAH (€ 422.496 (95% CI 258.489 to 586.503) versus € 329.193 (95% CI 242.142 to 416.244); p=0.039). The difference in direct costs between high-and low-grade was significant (€ 81.040 (95% CI 68.566 to 93.515) versus € 46.055 (95% CI 41.500 to 50.610); p<0.001), but there was no significant difference in indirect costs between both groups (€ 341.456 (95% CI 178.923 to 503.988) versus € 283.645 (95% CI 197.467 to 369.822); p=0.076). Effective costs per patient with favorable outcome (GOSE 5-8) were 2.1-fold greater for high-grade compared to low-grade aSAH (€ 806.583 versus € 386.444).

The costs per patient stratified by GOSE scores are shown in Figure 4. Total costs were greater in patients with GOSE 5-6 (€ 700.927 (95%CI 528.170 to 873.685)) compared to GOSE 7-8 (€ 137.499 (95% CI 80.624 to 194.374); p<0.001) and GOSE 2-4 (€ 483.168 (95% CI 296.080 to 670.256); p= 0.046). Direct costs increased successively with increasing degree of disability (GOSE 7-8: € 39.978 (95% CI 35.626 – 44.330); GOSE 5-6: € 57.878 (95% CI 47.477 to

68.310); GOSE 2-4: € 88.214 (95% CI 76.377 to 100.051) and indirect costs were greater in patients with GOSE 5-6 (€ 643.049 (95% CI 470.040 to 816.058) compared to GOSE 7-8 (€ 40.562 (95% CI 10.349 to 70.774); p<0.001) and GOSE 2-4 (€ 394.954 (95% CI 207.094 to 582.814); p= 0.007).

DISCUSSION

The study shows that favorable outcome after aSAH can be achieved in more than three-quarters of survivors and nearly two-third report on work recovery in the long term. Favorable outcome is more frequent in low-grade (85%) compared to high-grade aSAH (52%). The total costs were € 344.277 per patient, which mainly accounted to indirect costs from productivity losses (84%). Acute in-hospital treatment was the main component of direct costs with an average of € 33.200 per patient. The total costs increase with increasing degree of disability and are greater for high-grade compared to low-grade aSAH. The effective costs per patient with favorable outcome is 2.1-fold greater for high-grade compared to low-grade aSAH.

In the current era of aSAH management, treatment of high-grade aSAH is associated with favorable outcome in more than half of survivors in the long-term. Immediate initiation of neuroresuscitation in combination with early aneurysm occlusion resulted in good functional recovery in a considerable proportion of patients with high-grade aSAH [4,14]. Recently, Schwartz et al. investigated functional recovery after high-grade aSAH and reported that 40 of 62 survivors (65%) regain functional independence at 3 years after diagnosis [3]. Outcome assessment beyond the first year after aSAH might be of particular importance, since delayed functional recovery has been reported in approximately 20% of high-grade aSAH patients [15]. This was further corroborated by the findings of individual GOS improvements in our study.

In a consecutive cohort of aSAH patients, work recovery can be achieved in nearly two-thirds of survivors in the long-term. Up to date, only few studies reported on work recovery after aSAH [12,16]. For low-grade aSAH patients with good functional recovery, Sonesson et al. found that 61 of 67 patients (91%) return to work at 25 years after aSAH [17]. On the other hand, Passier et al. reported that 54 of 88 patients (61%) return to work if they were living at home at 3 years after aSAH [18]. However, all previous studies on work recovery included patients who were independent and living at home. Thus, the results are difficult to interpret with regards to the general aSAH population, which also includes a significant number of patients who are partially or fully dependent and living in a nursing home or sheltered housing program. To the best of our knowledge, our study is the first investigation on work recovery in a consecutive cohort of high- and low-grade aSAH patients including all levels of functional recovery.

Costs for aSAH rise considerably with increasing degree of disability in the long term. Despite the high level of resource use during acute hospital treatment, delayed ischemic neurological deficit (DIND) remains a major cause of poor outcome after aSAH. In a post-hoc analysis of the International Subarachnoid Hemorrhage Trial (ISAT), Rivero-Arias et al. showed that patients with DIND had a considerably increased hospital stay and fewer workdays at 2 years after aSAH [6]. Consequently, there were substantial differences in costs for hospital treatment (€ 10.475) and productivity losses (€ 4.317) favoring patients without DIND. Unfortunately, no conclusions on cost-effectiveness can be drawn from the study because data on functional recovery are lacking. Indirect costs due to productivity losses after aSAH have been described in one other study [8]. In this study, indirect costs per patient accounted for 41% (€ 15.800) of the total costs within the first year after aSAH (€ 38.300). Thus, so far data on long-term indirect costs due to productivity losses after aSAH were missing. In our cohort, indirect costs were greatest in patients with moderate disability (GOSE 5-6), who were independent but unable to return to their previous work fully or in part. In fact, indirect costs from productivity losses in

the long term (€288.426 per patient) made up for 84% of total costs (€344.277 per patient). On the other hand, direct costs from acute in-hospital and rehabilitation treatment are considerably less compared to the long-term health-economic consequences of failure to return to work or incomplete work recovery.

The effective costs per patient with favorable outcome are substantially greater for high-grade aSAH compared to low-grade aSAH. Although several studies have identified the initial clinical presentation as the main cost-driving factor after aSAH [5,6,19], only one study reported on costs after high-grade aSAH more than 15 years ago [20]. In this study, 64 of 148 high-grade aSAH patients (43%) were treated by either clipping (92%) or coiling (8%), the remaining patients were treated conservatively and died. Favorable outcome was achieved in 22 of 64 patients (34%) and the costs per favorable outcome were € 95.299. In recent decades, a marked shift towards treatment of higher severity in the aSAH population has been observed [21]. Outcome improvements possibly reflect the major advances in aneurysm treatment modalities and extended resources in neurocritical care. Today, treatment of high-grade aSAH is associated with favorable outcome in more than half of survivors as shown by our results. However, treatment of high-grade aSAH is costly and possibly more than 2-fold greater compared to low-grade aSAH if favorable outcome is achieved. Future advances in aSAH management aiming to prevent secondary brain injuries might decrease costs from productivity losses and thus affect the socioeconomic burden of aSAH beneficially.

Our study has several limitations that need some considerations. Firstly, costs were calculated according to daily costs from hospitalization and productivity losses due to failure to return to work. Therefore, costs may have been underestimated because diagnostics, treatment costs, outpatient care, medications, potential out-of-pocket costs, household production impacts and caregiver time costs were not captured. These additional components might in fact account for

up to 20% of direct costs as suggested previously [8]. Secondly, informed consent to participate in this study was not available for deceased patients or their relatives. The exclusion of non-survivors (n=36) might lead to an underestimation of costs. Furthermore, selection bias may have occurred because not all patients responded to the mailed questionnaire or gave informed consent. However, a dropout rate of 12% (20 of 170 patients receiving mailed invitation to participate in the study) might be considered as acceptable. Finally, the single center design with a relatively small sample size limits generalization of the data on a national level.

CONCLUSIONS

This study provides a first impression on long-term outcome, work recovery and costs in a consecutive cohort of high- and low-grade aSAH patients including all levels of functional recovery. Future multicenter studies are needed to understand the true economic burden of aSAH on society and patients. Because long-term disability and high-grade aSAH are important sources of rising costs after aSAH, there is an ongoing need to further improve management strategies for early detection and prevention of secondary brain injuries associated with unfavorable outcome and failure to return to work.

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FIGURE LEGENDS

Figure 1: Flow chart of the study population and follow-up

Figure 2: Distribution of Glasgow Outcome Scale (GOS) scores at 3- and 12-months as well as long-term follow-up after aneurysmal subarachnoid hemorrhage (aSAH)

Figure 3: Percentage of individual changes in Glasgow Outcome Scale (GOS) between 12 months and long-term follow-up after aneurysmal subarachnoid hemorrhage (aSAH)

Figure 4: Total costs (A), direct costs (B) and indirect costs (C) per patient between high- and low-grade aneurysmal subarachnoid hemorrhage (aSAH)

Figure 5: Total costs (A), direct costs (B) and indirect costs (C) per patient stratified by Glasgow Outcome Scale Extended (GOSE) scores

Table 1: Glasgow Outcome Scale (GOS) and Glasgow Outcome Scale Extended (GOSE)

GOS		GOSE		Key Features
5	GR	8	GR^+	Resumption of normal life
		7	GR^-	Minor disability due to neurological or psychological deficits
4	MD	6	MD^+	Disability and deficits of cognition or personality Independent at home and works at a reduced capacity
		5	MD^-	Disability and deficits of cognition or personality Independent at home but unable to work
3	SD	4	SD^+	Partially dependent but able to be alone at home for >8 hours
		3	SD^-	Fully dependent with someone around most of the time
2	VS	2	VS	Condition of unconsciousness
1	D	1	D	Death

GOS, Glasgow Outcome Scale; GOSE, Glasgow Outcome Scale-Extended; GR, good recovery; MD, moderate disability; SD, severe disability; VS, vegetative state; D, death

Table 2: Patient characteristics after aneurysmal subarachnoid hemorrhage (aSAH)

	All patients (n=150)	**High-grade aSAH (n=42)**	**Low-grade aSAH (n=108)**	p-value
Age in years; mean (SD)	55 (24-81)	56 (34-78)	54 (24-81)	0.5
Female sex; n (%)	98 (65)	31 (65)	67 (62)	0.2
Employed prior to aSAH	98 (65%)	23 (55)	75 (69)	0.1
Professional Position	37 (38%)	7 (30%)	30 (40%)	0.5
Support position	40 (41%)	12 (52%)	28 (37%)	0.5
Labor - Intensive	21 (21%)	4 (17%)	17 (23%)	0.8
Fisher Score; n (%)				
Fisher 1-2	35 (23)	1 (2)	34 (31)	<0.001
Fisher 3-4	115 (77)	41 (98)	74 (69)	
Aneurysm location; n (%)				
Anterior circulation	127 (85)	30 (71)	97 (90)	0.010
Posterior circulation	23 (15)	12 (29)	11 (10)	
Aneurysm treatment modality; n (%)				
Endovascular coiling	80 (53)	23 (55)	61 (57)	0.9
Microsurgical clipping	70 (47)	19 (45)	47 (44)	
Rescue Therapy; n (%)				
Decompressive Craniectomy	14 (9)	8 (19)	6 (6)	0.024
Barbiturate Coma	30 (20)	13 (31)	17 (16)	0.043
Therapeutic Hypothermia	33 (22)	14 (33)	19 (18)	0.048
Discharge destination; n (%)				
Home	18 (12)	3 (7)	15 (14)	0.4
Rehabilitation Unit	131 (87)	38 (91)	93 (86)	0.6
Nursing home	1 (1)	1 (2)	0 (0)	0.3
Length of stay in days, median (IQR)				
Intensive Care Unit	17 (15-29)	27 (18-40)	16 (145-21)	<0.001
Neurosurgical Ward	9 (6-15)	12 (7-21)	7 (6-14)	0.026
Rehabilitation Unit	36 (21-64)	60 (38-121)	29 (21-46)	<0.001
Glasgow Outcome Score, median (IQR)				
3-months after aSAH	4.0 (3.0-5.0)	3.0 (3.0-4.0)	4.0 (4.0-5.0)	<0.001
12-months after aSAH	4.0 (4.0-5.0)	3.0 (3.0-5.0)	5.0 (4.0-5.0))	<0.001

Table 3: Outcome after aneurysmal subarachnoid hemorrhage (aSAH) at long-term follow-up

Glasgow Outcome Scale Extended (GOSE); n (%)	All Patients (n=150)	High-grade aSAH (n=42)	Low-grade aSAH (n=108)
GOSE 8	34 (23)	8 (19)	26 (24)
GOSE 7	44 (29)	6 (14)	38 (35)
GOSE 6	26 (17)	5 (12)	21 (19)
GOSE 5	10 (7)	3 (7)	7 (7)
GOSE 4	16 (11)	8 (19)	8 (7)
GOSE 3	19 (13)	11 (26)	8 (7)
GOSE 2	1 (1)	1 (1)	0 (0)
Favorable Outcome (GOSE 5-8)	114 (76)	22 (52)	92 (85)
Unfavorable Outcome (GOSE 2-4)	36 (24)	20 (48)	16 (15)

Table 4: Work recovery after aneurysmal subarachnoid hemorrhage (aSAH) at long-term follow-up

Work recovery after aSAH; n (%)	All patients (n=98)	High-grade aSAH (n=23)	Low-grade aSAH (n=75)
Complete work recovery	36 (36)	5 (22)	31 (41)
Incomplete work recovery	25 (26)	4 (17)	21 (28)
No return to work	28 (29)	10 (44)	18 (24)
Early retirement after aSAH	9 (9)	4 (17)	5 (7)

Table 5: Costs per patient and total costs in Euro (€) after aneurysmal subarachnoid hemorrhage

	Mean	95% CI	Minimum	Maximum	Total
Direct Costs					
Acute in-hospital treatment (n=150)	33 220	33 772 – 35 667	8 928	111 600	4 982 940
Rehabilitation treatment (n=131)	20 056	16 908 – 23 204	0	117 480	2 928 200
Re-Hospitalization #1 (n=29)	3 181	1 800 - 4561	0	46 872	381 672
Re-Hospitalization #2 (n=8)	757	218 – 1 297	0	16 740	84 816
Indirect Costs					
Sick leave (n=98)	8 559	7 088 – 10 029	0	56 034	1 283 789
Early retirement (n=9)	10 158	2 301 – 18 016	0	338 289	1 523 758
Incomplete work recovery (n=25)	80 433	44 610 – 116 255	0	1 433 186	12 064 910
Failure to return to work (n=28)	189 276	117 954 – 260 599	0	1 999 320	28 391 468
Total direct costs (n=150)	55 851	50 440 – 61 262	8 928	204 168	8 377 628
Total indirect costs (n=150)	288 426	213 551 – 363 302	0	2 066 819	43 263 925
Total costs (n=150)	344 277	268 383 – 420 171	16 000	2 036 855	51 641 553